



Armed Forces College of Medicine AFCM



Male Reproductive System (1)

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INTENDED LEARNING OBJECTIVES (ILO)



After studying this lecture, the students should be able to:

- Outline the effect of temperature on spermatogenesis and the mechanisms that produce erection and ejaculation.
- Describe the significance of Blood-Testis Barrier
- Name the key hormones secreted by Leydig cells and Sertoli cells of the testes

Reproductive Functions



In males consists of :

1) Spermatogenesis

2) Secretion of the male sex hormones

3) Transport of sperm from the male to the female

Spermatogenesis

(the production of spermatozoa)



Spermiogenesis :

Remodeling of spermatid into mobile sperm without cell division; only differentiation and maturation under effect of :

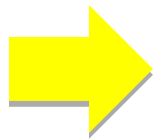
- FSH
- Testosterone
- Estrogen

- When the spermatozoa enter the seminiferous tubular lumen they are not capable of independent motility.
- Motility is acquired during storage in epididymis and vas deferens.

Factors Influencing Spermatogenesis

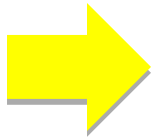


I. Hormonal factors

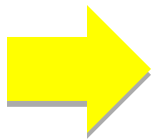


Testosterone

- Maintenance of germ epithelium .
- Mitosis and meiosis
- spermatogenesis



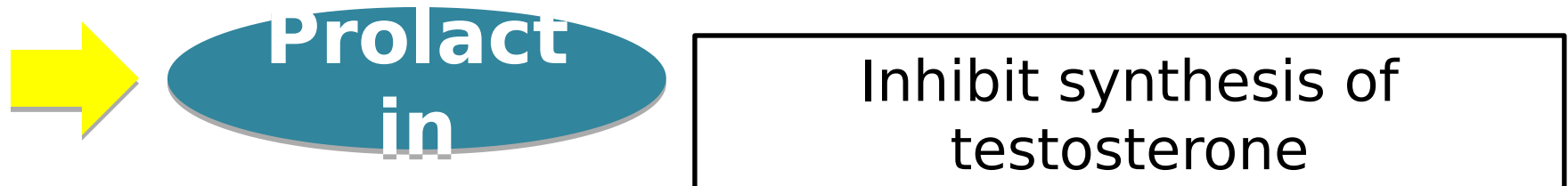
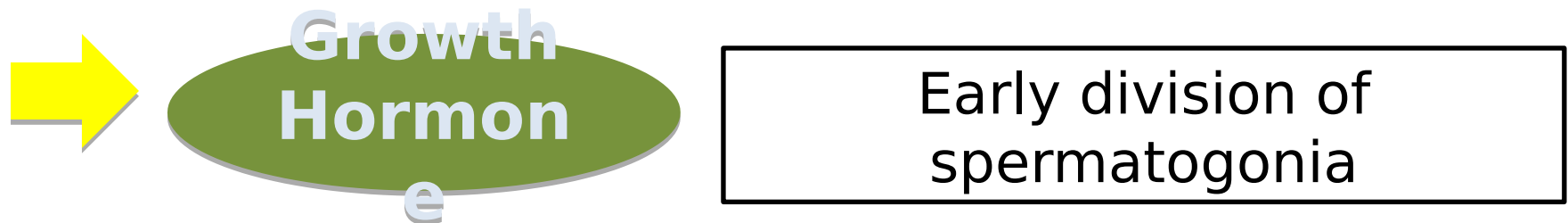
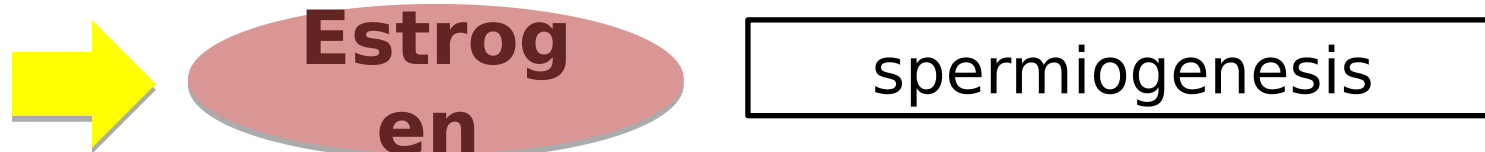
LH



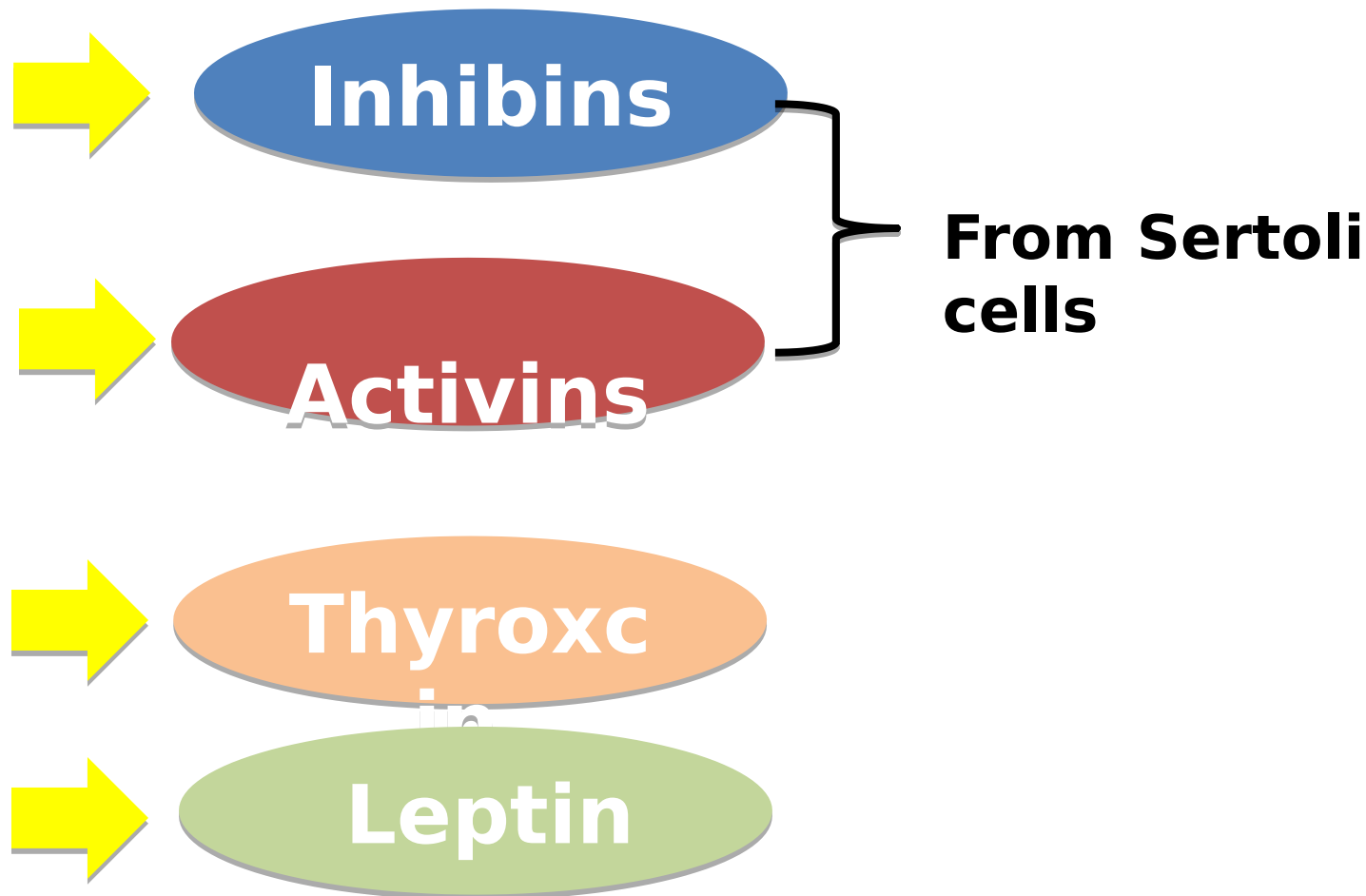
FSH

- Spermiogenesis
- Stimulate production of ABP

Factors Influencing Spermatogenesis



Factors Influencing Spermatogenesis



Factors Influencing Spermatogenesis



II. Temperature

Importance:

Spermatogenesis needs a temperature lower than body temperature (32°C) which is provided by the cooler environment in the scrotum.

Factors Influencing Spermatogenesis



How?

1- Positioning:

Presence of testis outside the abdominal cavity.

a) Testis is elevated toward abdominal cavity on exposure to cold environment by contraction of scrotal muscles (cremasteric muscle and dartos muscle).

b) Reverse, occur on exposure to heat.

(a) and (b) are reflexely controlled by the spinal cord.

Factors Influencing Spermatogenesis



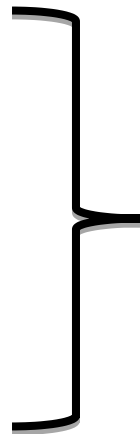
2- Blood supply arrangement:

Counter-current exchanger system.

Tight underpants

Hot baths more than
40° C

Prolonged fever



**Inhibit
spermatogenesis**

Factors Influencing Spermatogenesis



III. Diet

- Balanced diet.
- Necessary vitamins: A, B, C and E.



IV. Other Factors

- X- rays.
- Toxins (bacterial and chemical).
- Oxygen lack.

All inhibit spermatogenesis

Human Spermatozoon



- **Head:**

Covered by a cap(Acrosome):

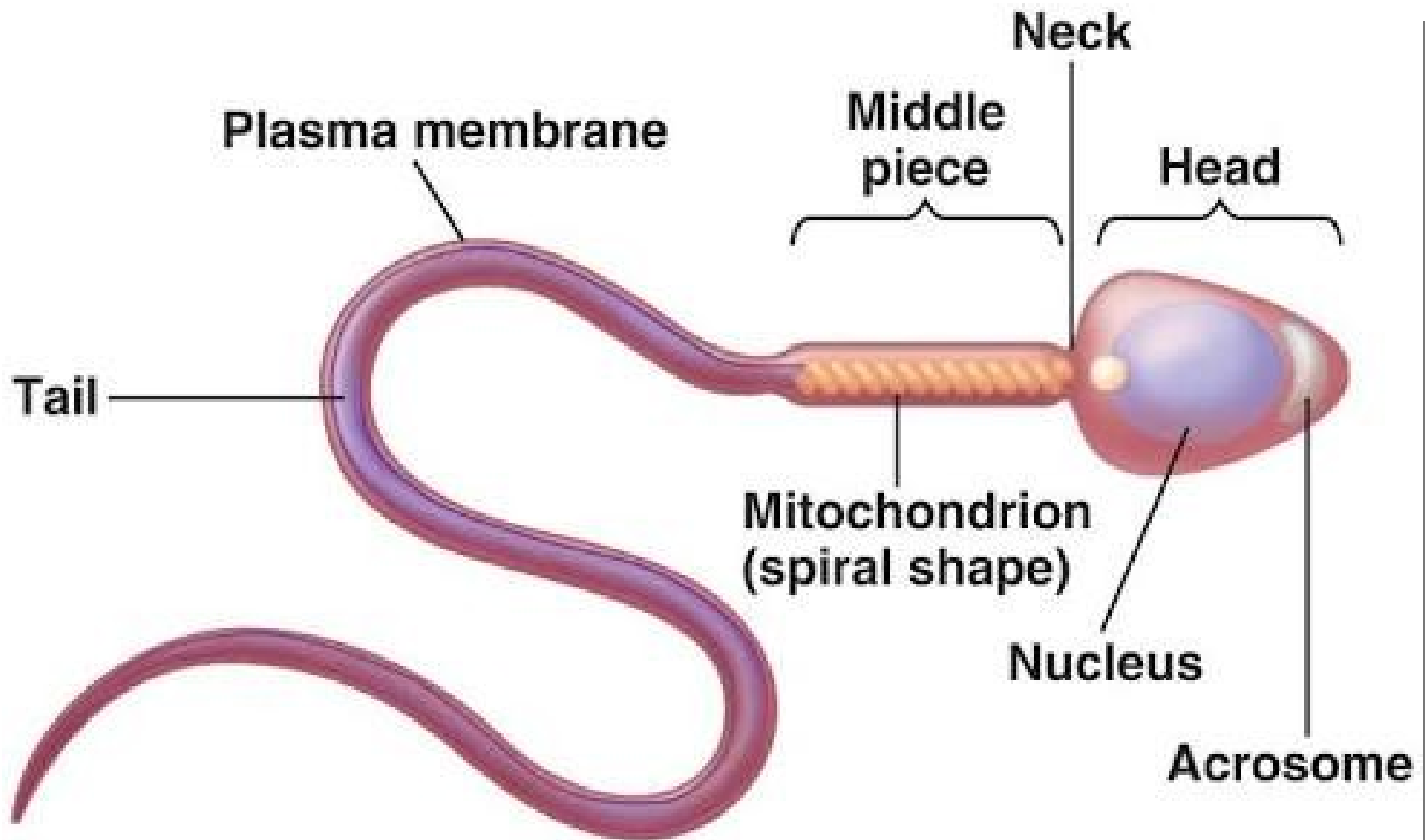
Lysosome-like organelle(rich in enzymes) → sperm penetration of ovum.

- **Tail:**

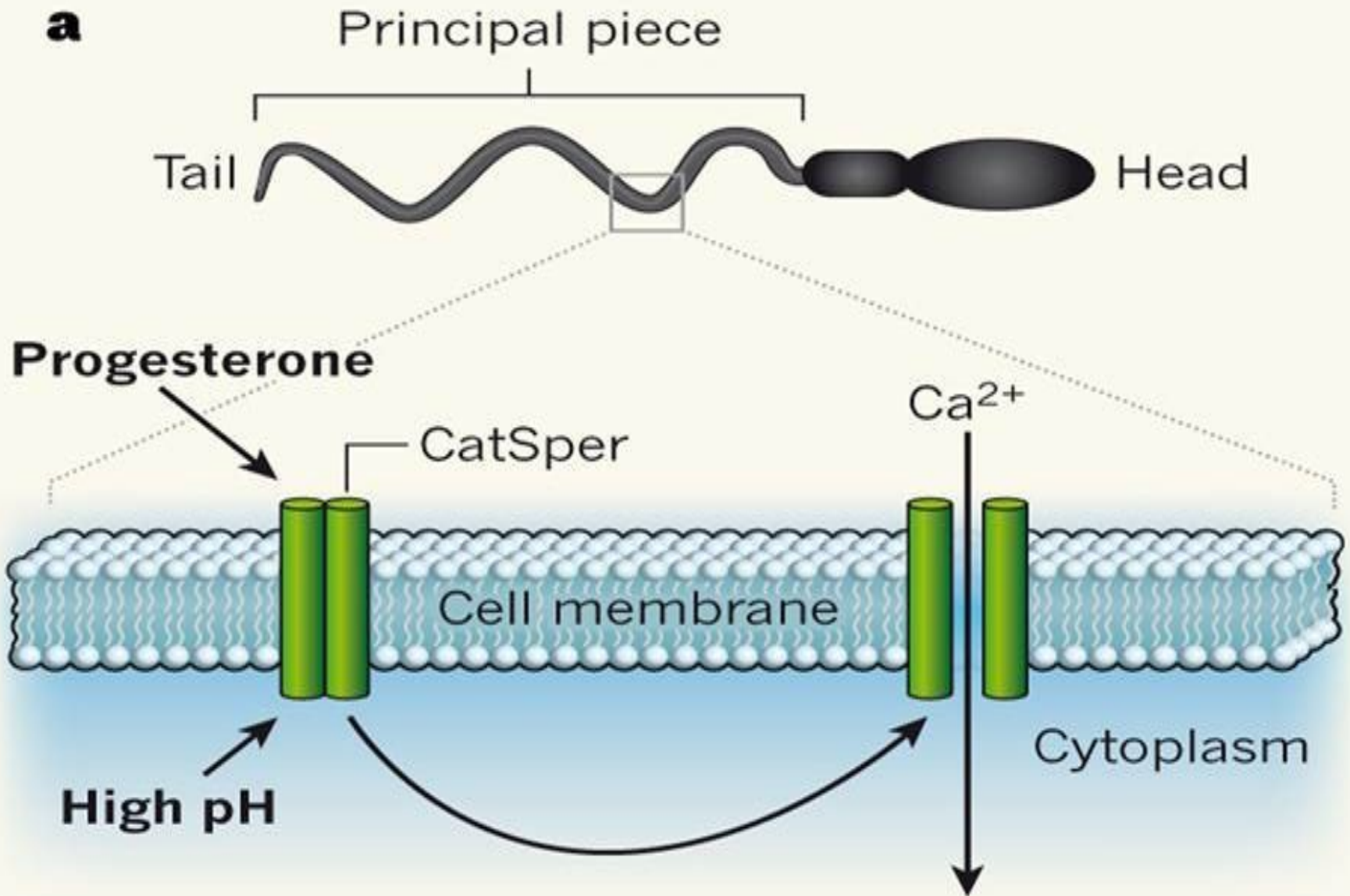
Its membrane contains germinal ACE with unknown function.

Its deficiency → infertility.

Human Spermatozoon



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Sperm Motility



- Depends on:

1- CatSper protein (cation channel of sperm):

Voltage- gated calcium channels.

Permit cAMP calcium influx into tail.

2- Olfactory receptors:

Expressed by spermatozoa, attracts sperms to odorant-like molecules produced by the ovaries.

Capacitation



- The physiological changes the sperm undergoes in order to have the capacity to fertilize the oocyte (penetrate it) in the female genital TR.
- Mechanism of capacitation:
 1. Inhibitory factors in seminal fluid are washed out.
 2. Cholesterol is withdrawn from sperm membrane.
 3. Surface proteins are redistributed.
 4. Calcium influx into sperm.
 5. + + + + Sperm motility.
 6. Preparation for acrosomal reaction.

Acrosomal membrane fuses with outer sperm membrane forming pores through which hydrolytic enzymes can escape from acrosome and penetrate the ovum.

The role of capacitation is facilitatory rather than obligatory as fertilization can occur invitro.

Capacitation



- The epithelial cells which line the *epididymis* secrete proteins which bind to the sperm cell membranes, to enhance their forward motility and ability to fertilize an ovum i.e CAPACITATION.
- Capacitation occurs mainly in the female genital tract.

The Testis



Descend:

Last months of fetal life (7th to 8th).

Hormonal control:

Dihydrotestosterone

Incidence of time:

- Complete in 98% of full term boys.
- Occurs before puberty in remaining 2 %.

Sertoli Cell



- **Extends from the B.M. to the lumen of the tubule.**
- **Joined by a tight junction to adjacent Sertoli cells.**



Blood testis barrier

Function of steroli cells in spermatogenesis:



I- Secretory function:

1- A fluid into lumen of seminiferous tubule that flushes the released sperm from the tubule into the epididymis.

This fluid is rich in androgens, estrogen, inositol, glutamic acid, aspartic acid and potassium.

This fluid is poor in glucose and protein.

Function of steroli cells in spermatogenesis:



I- Secretory function:

2- Androgen-binding protein: that binds testosterone to keep high concentration of testosterone within tubular lumen which is essential for spermatogenesis.

ABP secretion is stimulated by FSH.

Function of steroli cells in spermatogenesis:



3- Formation of estrogen:

Androgen $\xrightarrow{\text{Aromatase}}$ Estrogen.

4- Activin $\xrightarrow{\quad}$ + + + FSH.

5- Inhibin: -ve feedback for FSH regulation.

6-Mullerian-inhibiting factor: inhibition of Mullerian duct in male fetus during fetal life.

Function of steroli cells in spermatogenesis:



II- Site of action by testosterone and FSH:

For control of spermatogenesis.

III- Phagocytic function: of defective germ cells and cytoplasm extruded from spermatids.

Function of Sertoli cells in spermatogenesis:



IV- Nourishment of developing sperms:

Developing sperms have no direct access with blood.

Provide nutrients (glycogen).

V- Blood-testis barrier:

Sertoli cells are joined by tight junctions at a point beneath the outer membrane.

Function of blood testicular barrier:



- 1- Blood-borne harmful substances can not pass between to enter lumen of tubule.
 - Only selected molecules (testosterone and estrogen pass through Sertoli cells reach tubular lumen.
 - Tubular fluid is different from the blood i.e. rich in testosterone, estrogen, K^+ and amino acids (aspartic and glutamic acids).
- 2- Prevent immune cells in ECF from entering sperm factory i.e. prevent formation of antibodies against sperms.
- 3- Prevent antigenic products of germ cells from entering blood stream □ prevent formation of Ab

Lecture Quiz



Question 1

Which of the following best describes spermatogenesis ?

- a) Spermatogenesis requires continuous release of GnRH
- b) Spermatogenesis requires a temperature lower than internal body temperature
- c) LH acts on Sertoli cells to promote cell division
- d) Leydig cell secretion of testosterone requires FSH

Lecture Quiz



Question 2

In human males testosterone is produced by:


- a) Leydig cells
- b) Sertoli cells
- c) Seminiferous tubules
- d) Epididymis
- e) Vas deferens

SUGGESTED TEXTBOOKS



1. Ganong Review of Medical Physiology 25th

Edition from page 417 to 426



Thank You

New five year program

Endocrine & Genitourinary module